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The oribatid mite genus *Acaroceras* (Acari, Oribatida, Microzetidae)

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ABSTRACT — A new microzetid mite species, *Acaroceras* (*A.*) *brasiliensis* n. sp., is described from Brazil. It differs from the other representatives of the genus by the talon-like lamellar setae with ciliate branches (versus simple) and the presence of lamellar apophyses (versus absent). An identification key to the known subgenera and species of *Acaroceras* is provided. Three species of *Microzetes* are transferred to the genus *Berlesezetes*: *B. longistriatus* (Sarkar, 1992) n. comb., *B. monoramai* (Sarkar, 1992) n. comb. and *B. rudrasagarensis* (Sarkar, 1992) n. comb.

KEYWORDS — oribatid mites; new species; Microzetidae; *Acaroceras*; key; new combination; Brazil

INTRODUCTION

Acaroceras is an oribatid mite genus of the family Microzetidae (Acari, Oribatida) that was proposed by Grandjean (1936) with *Acaroceras odontotus* Grandjean, 1936 as type species. Later, Mahunka (1991, 1993) described two monotypic subgenera: *A. (Trichacaroceras)* Mahunka, 1991 with *A. (T.) africanus* Mahunka, 1991 and *A. (Malgoceras)* Mahunka, 1993 with *A. (M.) helleri* Mahunka, 1993. Currently, this genus comprises 20 species, which are distributed in the Ethiopian and Neotropical regions and Egypt (Subías 2004, updated 2014). Călugăr and Vasiliu (1977) described *Acaroceras feideri* Călugăr and Vasiliu, 1977, however, we do consider it as representative of the genus *Schalleria* Balogh, 1962 (see Ermilov *et al.* 2013).

The main diagnostic characters of the genus *Acaroceras* are (summarized from Grandjean 1936; Balogh 1962a, b; Mahunka 1991, 1993; Balogh and Balogh 1992, including our additions): bothridial setae setiform, ciliate, directed forward; lamellar

setae setiform, exception – talon-like with ciliate branches, inserted under distal parts of lamellae; interlamellar setae setiform, long, inserted on the basal parts of lamellae, directed forward; lamellae wide, without lateral tooth, separated medio-distally and fused medially in basal part, with teeth or rounded distally, not cover anterior and central parts of prodorsum; interlamellar apophysis present, simple, furcated or fungoid; lamellar apophyses usually absent, rarely present; notogaster without reticulate ornamentation and striae; usually 10 pairs of epimeral setae, exception – epimeral neotrichy present (correspond to subgenus *A. (Trichacaroceras)*); one or two (correspond to subgenus *A. (Malgoceras)*) pairs of aggenital setae; adanal lyrifissures located near to anal plates or antero-laterally (correspond to subgenus *A. (Malgoceras)*) to them.

During taxonomic identification of oribatid mites from Brazil, we discovered one new species of the genus *Acaroceras*. The main goal of our paper is to describe and illustrate it. In addition, we provide

an identification key for all known subgenera and species of *Acaroceras*, and proposed new systematic placement for *Microzetes longistriatus* Sarkar, 1992, *M. monoramai* Sarkar, 1992 and *M. rudrasagarensis* Sarkar, 1992.

MATERIALS AND METHODS

Three specimens (holotype: male; two paratypes: all males) of *Acaroceras (Acaroceras) brasiliensis* n. sp.: Brazil, 22°57' S, 43°09' W, Rio de Janeiro, Morro do Leme, Forte Duque de Caxias, 91 m a.s.l., Atlantic forest, soil litter (unknown date and collector).

Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. The notogastral width refers to the maximum width in dorsal aspect. Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers. Formulas for leg setation are given in parentheses according to the sequence trochanter-femur-genu-tibia-tarsus (femulus included). Formulas for leg solenidia are given in square brackets according to the sequence genu-tibia-tarsus. General terminology used in this paper follows that of F. Grandjean (summarized by Norton and Behan-Pelletier 2009). Drawings were prepared with the aid of a drawing tube using the Carl Zeiss compound microscope "Axioskop-2 Plus".

DESCRIPTION OF A NEW SPECIES

Acaroceras (Acaroceras) brasiliensis n. sp. (Figures 1-3)

Diagnosis — Body size: 192 – 196 × 147 – 151. Rostrum rounded. Two pairs of horn-like lobed structures present in anterior part of prodorsum. Lamellae rounded distally. Interlamellar apophysis bifurcate, three pairs of transverse lamellar apophyses located under inner parts of lamellae. Lamellar setae talon-like, with ciliate branches. Interlamellar setae long, rfar beyond the rostrum. Pteromorphs pointed distally and with tooth on anterior margin.

Notogastral setae minute, smooth. Epimeral setae setiform, barbed, little varied in length. Anterior pair of genital setae and aggenital setae well developed, barbed; other genital setae and anal and adanal setae minute, smooth.

Description — *Measurements*. Body length: 192 (holotype: male), 192 – 196 (two paratypes: both males); body width: 147 (holotype), 147 – 151 (two paratypes).

Integument — Body color light brownish to brown. General body surface smooth. Prodorsum between lamellae covered densely by filamentous cerotegument, notogaster covered by indistinct microgranular cerotegument. Lateral part of prodorsum and pedotecta I, and ventral plate nearly to posterior part of circumpedal carinae with short striae. Epimeral region with four long, strong longitudinal striae.

Prodorsum — Rostrum rounded. Two pairs of lobed structures present near to rostrum, all horn-like, directed upward in medio-basal part, and slightly backwards in distal part. Anterior pair (*sl1*) longer and thinner than posterior pair (*sl2*). Lamellae wide, fused medially in basal part by interlamellar apophysis (*ap*). Lamellae distally wide, outer and inner distal parts rounded, without teeth and indentations. Interlamellar apophysis bifurcate, with short, rectangular basal part and two long, thin branches, not reaching the level of insertions of lamellar setae. In addition, three pairs of transverse lamellar apophyses present: anterior (*apa*) and medial (*apm*) pairs simple, posterior pair (*app*) bifurcate. Rostral setae (*ro*, 41 – 45) setiform, slightly barbed, inserted on large tubercles. Lamellar setae (*le*, 16 – 20) talon-like, with eight long (41 – 49), simple, thin branches. Interlamellar setae (*in*, 110 – 123) setiform, thickened, smooth, far beyond the rostrum. Bothridial setae (*ss*, 98 – 106) setiform thickened, densely ciliate. Exobothridial setae and their alveoli not visible. Tutoria (*tu*) with long knife-like cusp.

Notogaster — Anterior margin distinct, straight. Pteromorphs pointed distally (*t*), with tooth (*tp*) on anterior margin. Nine pairs of short, setiform, smooth notogastral setae present, *c* (8) longer than others (4). All lyrifissures (*ia*, *im*, *ip*, *ih* and *ips*)

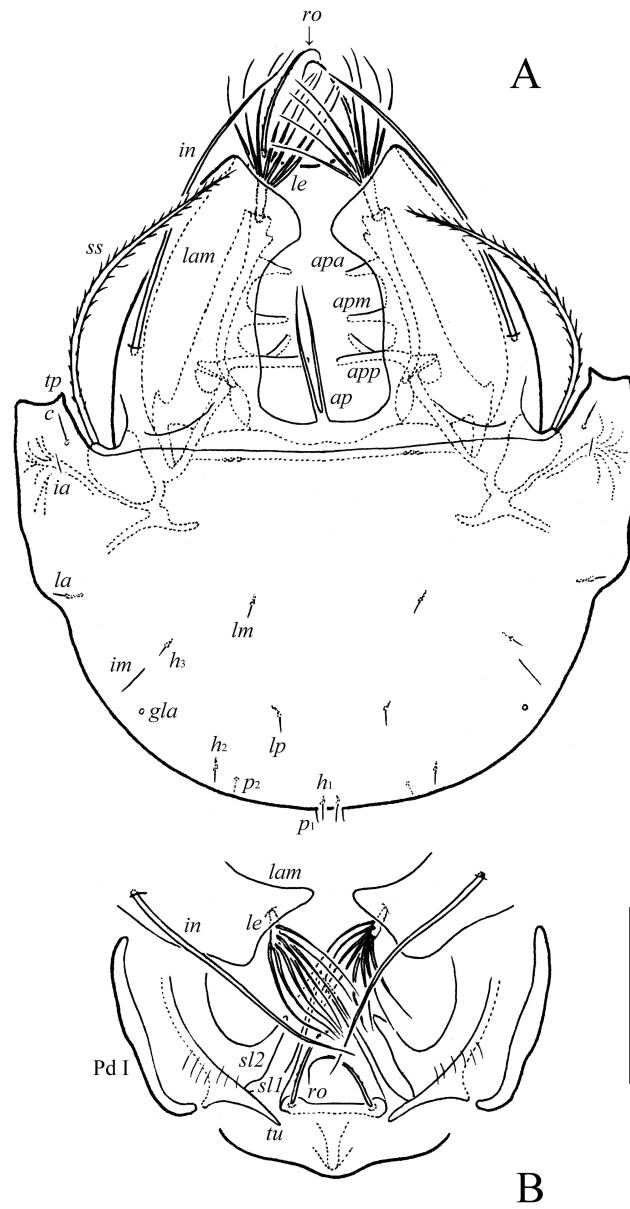


FIGURE 1: *Acaroceras (Acaroceras) brasiliensis* n. sp.: A – dorsal view; B – frontal view. Scale bar 50 μm.

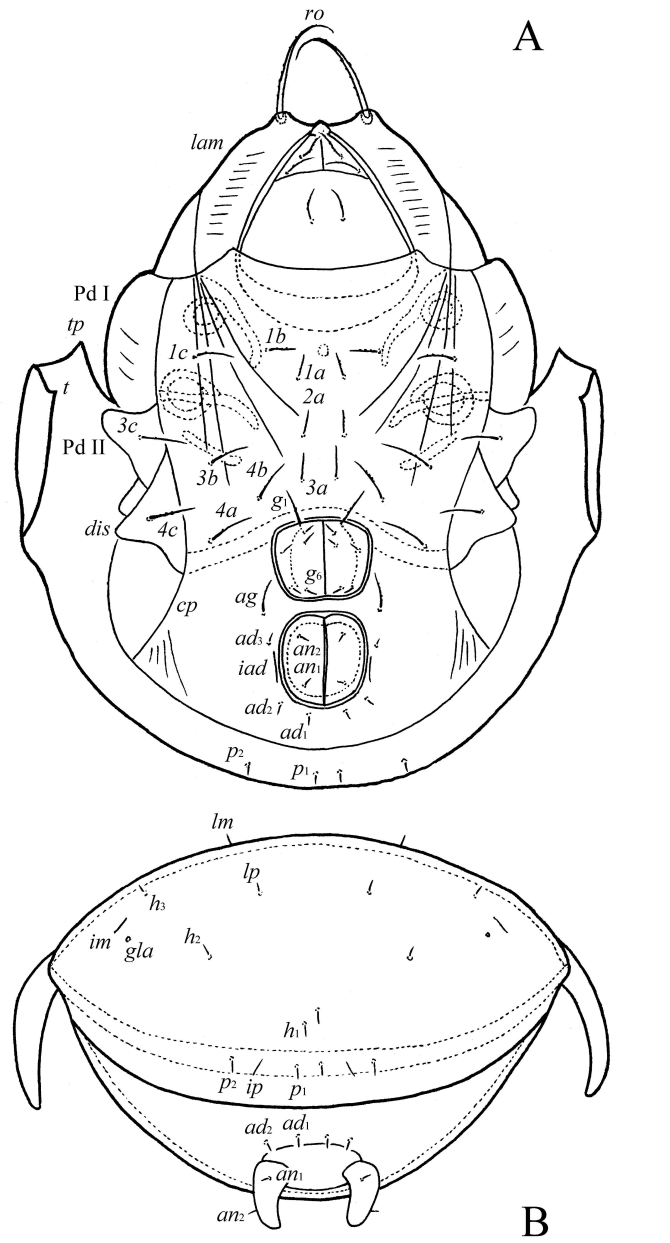


FIGURE 2: *Acaroceras (Acaroceras) brasiliensis* n. sp.: A – ventral view (legs not illustrated); B – posterior view. Scale bar 50 μ m.

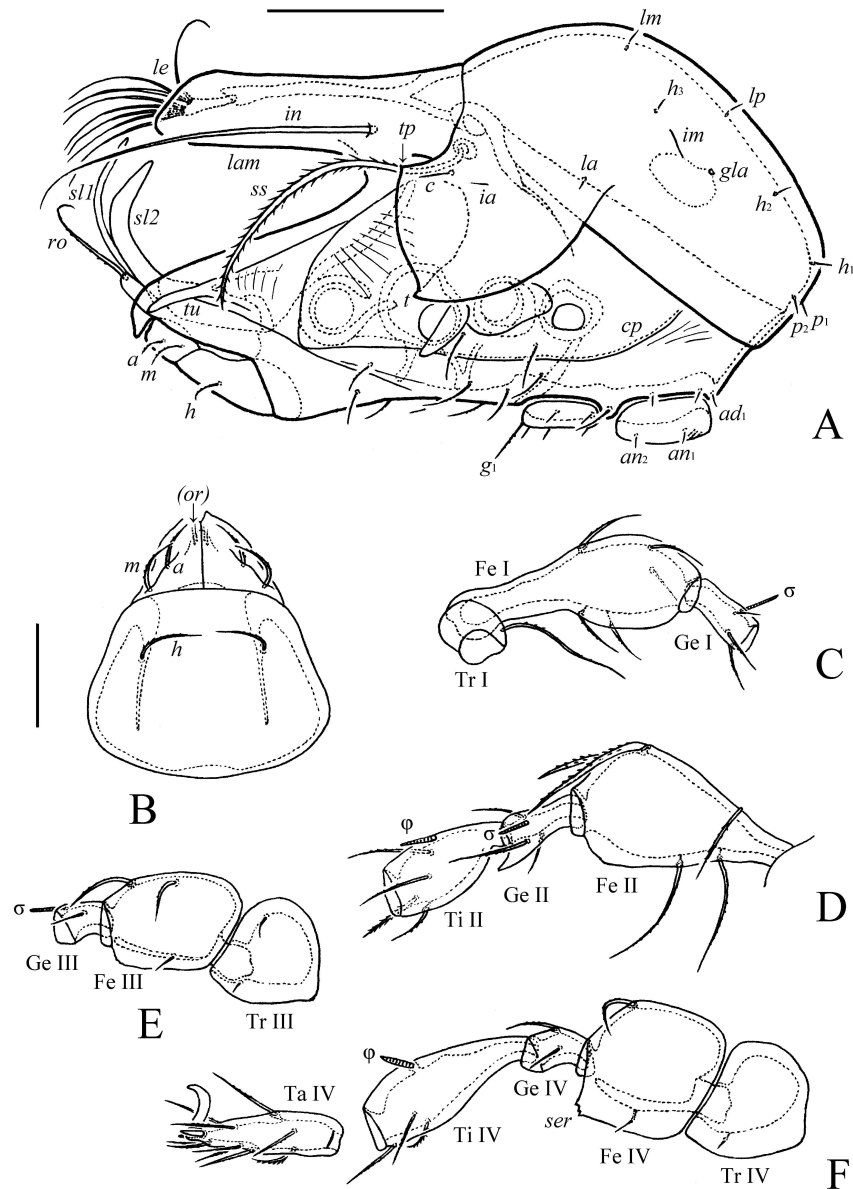


FIGURE 3: *Acaroceras (Acaroceras) brasiliensis* n. sp.: A – lateral view (legs not illustrated); B – subcapitulum, ventral view; C – trochanter, femur and genu of leg I, left, paraxial view; D – femur, genu and tibia of leg II, left, antiaxial view; E – trochanter, femur and genu of leg III, right, antiaxial view; F – leg IV, right, antiaxial view. Scale bar 20 µm.

distinct. Opisthonotal gland openings (*gla*) located posteriorly to *im*.

Gnathosoma — Generally, morphology is typical for Microzetidae (for example, Grandjean 1936; Engelbrecht 1972; Ermilov and Anichkin 2011; Ermilov et al. 2013). Subcapitulum slightly longer than wide ($49 - 53 \times 45 - 49$). Subcapitular setae (*h*, *m*, *a*) setiform, barbed, similar in length (12). Two pairs of adoral setae (*or*) minute (4), thin, smooth. Palps (45) with setation 0-2-1-3-9(+ ω). Chelicerae (57) with two setiform, barbed setae: *cha* (24) longer than *chb* (16). Cheliceral tubercle (8) straight, blunt-ended.

Epimeral and lateral podosomal regions — Epimeral setal formula: 3-1-3-3. All setae (16 – 24) simple, barbed. Setae 3*c* inserted on pedotecta II; setae 4*c* inserted on discidia. Epimeral border IV well developed. Pedotecta I (Pd I) large, scale-like (in lateral view), covering acetabula I. Pedotecta II (Pd II) rounded distally (in ventral view), partly covering acetabula II. Discidia (*dis*) large, triangular, rounded. Circumpedal carina (*cp*) distinct.

Anogenital region — Six pairs of genital setae simple, *g*₁ (14 – 16) slightly barbed, thicker and longer than other smooth setae *g*₂–*g*₆ (4). One pair of aggenital setae (*ag*, 12 – 14) setiform, slightly barbed. Two pairs of anal (*an*₁, *an*₂, 4) and three pairs of adanal (*ad*₁–*ad*₃, 4) setae minute, thin, smooth. Lyrifissures *iad* located in paraanal position.

Legs — Generally, morphology is typical for Microzetidae (for example, Grandjean 1936; Engel-

brecht 1972; Ermilov and Anichkin 2011; Ermilov et al. 2013). Claw of each leg smooth. Formulas of leg setation and solenidia: I (1-5-3-4-19) [1-2-2], II (1-5-3-4-15) [1-1-2], III (2-3-1-3-15) [1-1-0], IV (1-2-2-3-12) [0-1-0]; homology indicated in Table 1. Antero-ventral part of femora IV serrate (*ser*). Setae *p* setiform on tarsi I, thorn-like on tarsi II-IV. Famulus short, setiform, straight. Solenidia ω_1 on tarsi I and φ_1 on tibia I setiform, long, other solenidia short, slightly thickened, blunt-ended.

Type deposition — The holotype is deposited in the collection of the Senckenberg Institution Frankfurt, Germany; two paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Etymology — The name of the new species refers to the country of origin, Brazil.

Comparison — The known species of the genus *Acaroceras* can be distinguished by the key which is presented below.

Key to known species *Acaroceras*

1. Two pairs of aggenital setae ; adanal lyrifissures located antero-laterally to anal plates; body size: 234 – 245 \times 219 – 232 *A. (Malgoceras) helleri* Mahunka, 1993. Distribution: Madagascar.
— One pair of aggenital setae; adanal lyrifissures located laterally to anal plates 2
2. Epimeral neotrichy present; body size: 276 – 332 \times 216 – 230 *A. (Trichacaroceras) africanus* Mahunka, 1991. Distribution: Cabo Verde.

TABLE 1: Leg setation and solenidia of *Acaroceras* (*Acaroceras*)

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	<i>v'</i>	<i>d</i> , (<i>l</i>), <i>bv''</i> , <i>v''</i>	(<i>l</i>), <i>v'</i> , σ	(<i>l</i>), (<i>v</i>), φ_1 , φ_2	(<i>ft</i>), (<i>tc</i>), (<i>it</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>p</i> <i>v</i>), <i>v'</i> , (<i>pl</i>), ε , ω_1 , ω_2
II	<i>v'</i>	<i>d</i> , (<i>l</i>), <i>bv''</i> , <i>v''</i>	(<i>l</i>), <i>v'</i> , σ	(<i>l</i>), (<i>v</i>), φ	(<i>ft</i>), (<i>tc</i>), (<i>it</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>p</i> <i>v</i>), ω_1 , ω_2
III	<i>l'</i> , <i>v'</i>	<i>d</i> , <i>l'</i> , <i>ev'</i>	<i>l'</i> , σ	<i>l'</i> , (<i>v</i>), φ	(<i>ft</i>), (<i>tc</i>), (<i>it</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>p</i> <i>v</i>)
IV	<i>v'</i>	<i>d</i> , <i>ev'</i>	<i>d</i> , <i>l'</i>	<i>l'</i> , (<i>v</i>), φ	<i>ft''</i> , (<i>tc</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>p</i> <i>v</i>)

Roman letters refer to normal setae (ε to famulus), Greek letters to solenidia. Single prime (') marks setae on anterior and double prime (") setae on posterior side of the given leg segment.

Parentheses refer to a pseudosymmetrical of setae.

- Epimeral neotrichy absent.....3
3. Interlamellar apophysis fungoid.....4
— Interlamellar apophysis furcated distally or simple.....6
4. Anterior parts of lamellae with outer very long process; notogastral setae la , h_2 and h_3 slightly dilated distally, densely barbed; body size: 279×230 *A. (Acaroceras) index* Balogh and Mahunka, 1977(b). Distribution: Brazil.
— Anterior parts of lamellae without outer very long process; notogastral setae la , h_2 and h_3 slightly simple, smooth.....5
5. Outer and inner teeth of lamellae similar in size, small, triangular; interlamellar setae not reaching the anterior parts of lamellae; body size: $290 - 310 \times 230 - 236$ *A. (Acaroceras) becki* Balogh, 1962(a). Distribution: Peru.
— Outer tooth of lamellae slightly elongated, clearly longer than small, triangular inner tooth; interlamellar setae reaching the anterior parts of lamellae; body size: $212 - 220 \times 172 - 182$ *A. (Acaroceras) hamifer* Balogh and Mahunka, 1977(a). Distribution: Neotropical region.
6. Interlamellar apophysis trifurcated distally; body size: $267 - 286 \times 198 - 213$ *A. (Acaroceras) deshambrieri* Mahunka, 1983. Distribution: Neotropical region.
— Interlamellar apophysis not trifurcated distally.....7
7. Interlamellar apophysis bifurcated distally.....8
— Interlamellar apophysis simple.....15
8. Basal stalk of interlamellar apophysis clearly shorter than apical branches.....9
— Basal stalk of interlamellar apophysis not shorter than apical branches.....10
9. Lamellar setae talon-like, with long cilia; three pairs of lamellar apophyses; body size: $192 - 196 \times 147 - 151$ *A. (Acaroceras) brasiliensis* **n. sp.** Distribution: Brazil.
— Lamellar setae setiform, without long cilia; lamellar apophyses absent; body size: 223×172 *A. (Acaroceras) furcatus* Balogh, 1962(a). Distribution: Neotropical region.
10. Interlamellar setae not reaching anterior parts of lamellae.....11
— Interlamellar setae reaching anterior parts of lamellae.....12
11. Apical branches of interlamellar apophysis clearly shorter than basal stalk; antero-medial parts of lamellae connected; body size: 306×207 *A. (Acaroceras) schalleri* Balogh, 1962(a). Distribution: Peru.
— Apical branches of interlamellar apophysis similar to basal stalk in length; antero-medial parts of lamellae distinctly separated; body size: $278 - 301 \times 189 - 198$ *A. (Acaroceras) pseudofurcatus* Balogh and Mahunka, 1969. Distribution: Bolivia.
12. Antero-medial part notogaster with cavity; body size: 213×182 *A. (Acaroceras) cavernosus* Balogh, 1962(a). Distribution: Peru.
— Antero-medial part notogaster without cavity.....13
13. Distal margin of pteromorphs with one tooth; one pair of elongate-oval pores present laterally to anal plates; body size: $316 - 347 \times 245 - 265$ *A. (Acaroceras) porosus* Balogh and Mahunka, 1977(a). Distribution: Bolivia.
— Distal margin of pteromorphs with several teeth; pores absent in ano-adanal region.....14
14. Distal margin of pteromorphs with ten teeth; epimeral and anogenital regions striate; body size: $235 - 247 \times 190 - 198$ *A. (Acaroceras) oaxacinus* Mahunka and Palacios-Vargas, 1996. Distribution: Mexico.
— Distal margin of pteromorphs with four teeth; epimeral and anogenital regions not striate; body size: 282×210 *A. (Acaroceras) interiunctus*

Schatz and Palacios-Vargas, 1999. Distribution: Galápagos Islands.

15. Interlamellar apophysis short, 1/4-1/5 times as long of lamellae 16
— Interlamellar apophysis long, 1/2 times as long of lamellae 19

16. Interlamellar setae reaching the anterior parts of lamellae; antero-medial part of lamellae rounded; body size: 235 – 320 × 145 – 200.....
..... *A. (Acaroceras) galapogoensis*
Schatz and Palacios-Vargas, 1999. Distribution: Galápagos Islands. — Interlamellar setae not reaching the anterior parts of lamellae; antero-medial part of lamellae pointed 17

17. Inner margin of lamellae with one tooth; epimeral and anogenital regions not striate; body size: 277 × 206.....*A. (Acaroceras) aegypticus*
Al-Assiuty, Bayoumi, Abdel-Hamid and Khalil, 1988. Distribution: Egypt.
— Inner margin of lamellae smooth; epimeral and anogenital regions striate 18

18. Rostrum with two lateral horn-like processes; notogastral setae *lm* and *lp* minute, about 1/9 times as long of *h*₂; body size: 292 × 173.....*A. (Acaroceras) taurus*
Schatz and Palacios-Vargas, 1999. Distribution: Galápagos Islands.
— Rostrum without lateral horn-like processes; notogastral setae *lm* and *lp* well developed, about 1/2 times as long of *h*₂; body length: 220 – 260.....*A. (Acaroceras) odontatus*
Grandjean, 1936. Distribution: Venezuela.

19. Interlamellar setae reaching the anterior parts of lamellae; body size: 255 × 168.....*A. (Acaroceras) similis*
Balogh, 1962(a). Distribution: Peru.
— Interlamellar setae not reaching the anterior parts of lamellae 20

20. Antero-medial part of lamellae rounded; body size: 202 × 153 *A. (Acaroceras) pugio*

Balogh, 1962(a). Distribution: Peru.

— Antero-medial part of lamellae with tooth; body size: 233 – 255 × 166 – 177.....
..... *A. (Acaroceras) szerediae*
Mahunka and Mahunka-Papp, 2009. Distribution: Kenya.

REMARKS ON SYSTEMATIC PLACEMENT OF SOME MICROZETIDAE

The analysis of literature on the Microzetidae has revealed an incorrect systematic placement of three species of the genus *Microzetes* Berlese, 1913, which were described by Sarkar (1992) from India: *M. longistriatus* Sarkar, 1992, *M. monoramai* Sarkar, 1992 and *M. rudrasagarensis* Sarkar, 1992. All morphological traits of these species correspond to those of the genus *Berlesezetes* Mahunka, 1980. Hence, they should be combined in the latter genus: *B. longistriatus* (Sarkar, 1992) n. comb., *B. monoramai* (Sarkar, 1992) n. comb. and *B. rudrasagarensis* (Sarkar, 1992) n. comb.

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